DESCRIPTION

Bleed valve

The invention relates to a bleed valve according to the preamble of claim 1.

Bleed valves of this type are normally configured for vertical installation into the wall of the fuel tank of a vehicle and are intended to provide a continuous connection between the inner chamber of the tank above a fuel level and the outside environment, so that in the open position, air is able to escape from the tank during the filling procedure and air can flow into the tank as fuel is consumed, in order to prevent a vacuum from building up. In the event that the tank is overfilled or that the position of the valve is substantially deviating from its usually topside position on the tank, said last condition indicating that an accident has occurred or that the vehicle has overturned going along with a risk that fuel may leak out in an uncontrolled manner the valve should be switched to its closed position. Therefore, in dependence upon the operating state of the tank or the vehicle, a facility for automatically switching the valve should be configured in a reliable manner between an open position and a closed position. In particular, characteristic vehicle movements which are determined by the drive operation are also to be taken into consideration for the operation of the valve.

A valve of this type is disclosed e.g. in DE 696 01 135. A floating body which cooperates with an elongate, strip-like, flexible membrane is disposed inside a cylindrical housing which on the base-side comprises inlet orifices and on the topside comprises an outlet orifice. The floating body can move axially inside the housing between an open and a closed position of the valve and is supported on the base-side by a spring. The movement of the floating body inside the housing and thus the switching position of the valve is thus determined quantitatively by the lifting force, which acts upon the floating body and is dependent upon the fuel level, by a mass force and by the force of the spring. On its side facing towards the floating body the outlet orifice which is configured in an elongate or slit-like manner forms with its rim a valve seat for the membrane which is fixed in the closed position of the valve between the valve seat, which extends in an inclined manner with respect to the axis of the housing, and a counter surface of the

floating body which extends in parallel with said valve seat. The membrane is secured merely at one end to the floating body. By reason of the inclined orientation of the valve seat and of the counter surface relative to the axis of the housing and thus the movement direction of the floating body, the opening of the valve is characterised by the fact that the membrane becomes gradually detached from the valve seat.

US 4,753,262 discloses a further bleed valve for the fuel tank of a vehicle, in which a floating body which is supported on the base-side by a spring is disposed in such a manner as to be able to move axially in a cylindrical housing which is provided with base-side inlet orifices. Furthermore, the housing is provided with a topside outlet orifice, of which the side facing towards the floating body forms a circular ring-shaped valve seat which is operatively connected to the membrane. Located on the topside of the floating body is a retaining element which forms a cage for the membrane and which is characterised by fingers which are disposed distributed uniformly in the peripheral direction and whose free ends the membrane is partially overlapped in the radial direction [sic]. In the axial direction of the housing the fingers comprise different lengths which are dimensioned with the proviso that in the event of a downwardly directed movement of the floating body which causes the outlet orifice to be revealed, the opening procedure begins at the point on the periphery of the outlet orifice which is allocated to the axially shortest finger so as to establish in turn an opening procedure which starts gradually. The valve seat extends similar manner to a counter surface of the floating body perpendicularly with respect to the axis of the housing.

Against this background, it is the object of the invention to provide a bleed valve of the generic type defined in the introduction such that an improved guiding effect is exerted upon the sealing element both during the opening movement and closing movement of the valve, in particular taking into account positional changes of the valve which result from the drive operation. In the case of a bleed valve of this type, this object is achieved by the features of the characterising portion of claim 1.

Accordingly, it is essential to the invention that in contrast to the prior art set forth in the introduction, it is not a surface which is structurally connected in a fixed manner to the floating body but rather the side of a support disc which faces towards the sealing element and for its part is articulated in a cardanic manner with respect to the floating

body which acts [lacuna] the counter surface for the sealing element. This means that positional changes, in particular inclined positions which result from the driving operation, can be compensated for in a defined frame, so that the sealing function is not impaired. In terms of material, the support disc will regularly differ in view of its function from the sealing element and consist of a less elastic material, preferably synthetic material, which is relatively harder in comparison with the sealing element. In contrast, the sealing element is subjected to a support effect which stabilises its configuration and accordingly can consist of a relatively softer material which is adapted to fulfil a sealing function. These measures lead to improved guidance of the sealing element whilst at the same time improving the integrity of the seal.

The features of claim 2 which are known per se in the case of bleed valve which are to be associated with the prior art are applied in accordance with the invention for the purpose of controlling the movement of sealing elements which cooperate with a support disc which is articulated in a movable, in particular cardanic manner with respect to the floating body, in order to reduce the expenditure of energy during opening and closure of the valve and thus to increase the reliability thereof.

The housing and the floating body which is located therein can comprise a structure which is rotationally symmetrical in relation to a central axis, so that the floating body moves between the open and closed position of the valve generally in the direction of the axis of the housing. However, a configuration of the housing and of the floating body which differs from the rotationally symmetrical shape is equally possible. According to the features of claims 3 and 4, the valve seat can be disposed correspondingly in a plane extending perpendicular to the axis of the housing or to the longitudinal extension thereof.

The features of claim 5 are directed to a further way of constructing a cardanic articulation of the support disc whilst at the same time taking into account the detachment of the sealing element which commences at a point on the periphery of the valve seat during opening of the valve. Accordingly, one of the two pivot axes is characterised by an inclined position with respect to the axis of the housing. The other pivot axis extends perpendicularly with respect to the axis of the housing. In the event of a non-cylindrical housing, the same applies in relation to its longitudinal extension.

The features of claim 6 are directed to a further structural embodiment of the inventive cardanic articulation of the support disc.

The features of claims 7 and 8 are directed to the improvement in the guiding effect exerted upon the movement of the support disc. These features on the whole improve the reproducibility of the movements of the support disc, the integrity of the sealing effect and the smoothness of the said movements.

The invention will be explained in detail hereinunder with reference to the exemplified embodiment which is illustrated by way of example in the drawings, in which

Figure 1 shows an exploded view of the essential components of the bleed valve in accordance with the invention;

Figure 2 shows an axial sectional view of the bleed valve of Figure 1 in the open position;

Figure 3 shows an axial sectional view of the bleed valve of Figure 1 in the closed position;

Figure 4 shows an axial sectional view of the bleed valve of Figure 1 at the commencement of a new opening procedure;

Figure 5 shows a plan view of the floating body in accordance with a viewing direction V-V of Figure 1;

Figure 6 shows a sectional view and partial view of the installation state of the bleed valve.

Reference will be initially made hereinunder to Figures 1 to 2 and 5 of the drawings. As shown therein, the bleed valve consists of a cylindrical housing 1 which is closed off on the topside by means of a preferably detachably inserted cover 2, and of a generally likewise cylindrical floating body 3 which is disposed in the housing 1 in such a manner as to be able to move in the direction of the axis 5 thereof.

The floating body 3 can be guided in a non-rotatable manner inside the housing 1 in relation to the axis thereof by virtue of means which are known per se and are effective in a positive-locking manner.

The housing 1 is provided on the topside with two mutually adjacent inlet orifices 4 and an outlet orifice 6 which extends in a coaxial manner with respect to the axis 5 is located in the cover 2. The outlet orifice terminates on the outer side in a connecting piece 7 which is intended for the connection of an output line.

The floating body 3 is supported in a manner known per se on the underside by way of a spring, not illustrated, on the base 1' of the housing 1, the mode of operation of said spring will be explained hereinunder. The floating body is provided with an annular-cylindrical chamber 8 which is open towards the underside 3' of the floating body and extends substantially coaxially with respect to the axis 5, wherein the said spring is supported on the closed chamber base 9 of said chamber.

The topside 3" of the floating body 3 is characterised by a ring-like arrangement of identically configured support fingers 10 which extends substantially coaxially with respect to the axis 5, said support fingers are formed in one piece with the floating body 3 at uniform peripheral spaced intervals and protrude from the otherwise planar topside, which is radial in relation to the axis 5, of said floating body. The reference numeral 11 designates an approximately circular pyramid-shaped guide mandrel which is located in a central position inside the ring-like arrangement and protrudes from the topside 3" and whose significance will be explained hereinunder. In the illustrated exemplified embodiment, the guide mandrel comprises a shorter axial extension than the support fingers 10.

The reference numeral 12 designates a support disc which in the peripheral region forms an annular step which is adjoined by an annular flange 13. The support disc 12 comprises a central circular orifice 14, into which protrudes a cylindrical projection 16 which is formed in one piece with a sealing disc 15 and by means of which the sealing disc is releasably connected to support disc 12. The sealing disc 15 overlies the support disc 12 on its side facing away from the floating body 3. The annular step of the support disc 12 encompasses the outer side of the arrangement of support fingers 10 and as a result thereof is subjected to a substantially axially directed guiding movement. A guiding or centring effect is also exerted by virtue of the said guide mandrel 11 which protrudes into the end of the projection 16 facing towards said guide mandrel. The projection 16 also forms a continuous connection 16' between its end facing towards the guide mandrel 11 and its end facing towards the valve seat 19.

The reference numerals 17, 17' designate two angular retainer elements which are attached in a mutually diametrically opposed manner to the floating body 3 and are intended for the positive-locking engagement over the said annular flange 13 and whose axial lengths are different in dimension. This means that the possibilities available for moving the support disc 12 with respect to the two retainer elements 17, 17' accordingly turn out to be different. In each case, according to the dimensions of the two retainer elements 17, 17' the entire system consisting of a support disc and sealing disc 12, 15 is subjected to an approximately cardanic suspension or mobility on or with respect to the floating body.

The outlet orifice 6 is characterised by a comparatively short tubular element 18 which extends coaxially with respect to the axis 5 and protrudes into the housing 1 and whose free end 19' forms a valve seat 19 for the sealing disc 15.

As shown in detail in Figure 6, a bleed valve of this type is intended for installation into the topside wall 20 of the fuel tank 21 of a vehicle. The fuel tank is filled to a permissible level 22, so that in the type of installation shown where the housing 1 is located almost completely inside the tank, the inlet orifices 4 communicate merely with the head space 23 above the fluid. Other types of assembly of the bleed valve, in which the housing is located substantially outside the tank, are equally possible, wherein the inlet orifices have to be placed in different positions accordingly. However, this will be not be discussed further hereinunder.

As is known per se, the position of the floating body 3 inside the bleed valve, which is oriented vertically in the installed condition, is determined according to the forces which act upon the floating body, namely a resilient force which acts upon its underside 3', a lifting force in dependence upon the fluid level inside the housing 1 and a mass force, wherein the said spring in conjunction with the material of the floating body 3 is selected with the proviso that in the open position of the valve as illustrated in Figure 2 which is normally characterised by the absence of a lifting force, the resilient force is overcome by the mass force of the floating body 3 including the parts which are connected thereto and the floating body 3 sinks to the base 1' of the housing 1. In this case, a continuous connection is established between the inlet orifices 4 and the outlet orifice 6, so that it is possible to ventilate and similarly bleed the tank substantially without any hindrance.

The sealing disc 15 in this position thus does not have any contact with the valve seat and the support disc 12 lies on the underside on the guide mandrel 11 which at the same time exerts a centring effect upon the sealing disc or the support disc. A radial guiding effect is also exerted by the support fingers 10, the radial outer sides of which are disposed at a small spacing with respect to the radial inner side of the annular step of the support disc 12.

Reference will also be made hereinunder to the Figures 3, 4 of the drawings, in which functional elements which correspond to those illustrated in Figures 1, 2, 5 or 6 are designated with like reference numerals so as to obviate any repetition of the description in this respect.

The closed state of the bleed valve as illustrated in Figure 3 is characterised by virtue of the fact that e.g. under the influence of a lifting force which is effective in addition to the resilient force and the said mass forces, the floating body 3 has moved inside the housing 1 in the direction of the cover 2, so that the sealing disc 15 lies against the valve seat 19. The stabilising effect of the support disc 12 provides a reliable and reproducible sealing effect. At the same time, in this position the projection 16 is urged into sealing abutment against the guide mandrel 11. The retainer elements 17, 17' do not function when the valve is in this position.

The closed state of the bleed valve can occur as a result of the tank being overfilled or in the event of an orientation of the position of the axis of the valve which deviates substantially from the vertical orientation and which can be instigated by corresponding vehicle movements, in particular swinging movements, the negotiation of turns with a change in orientation, but also as a result of an accident, e.g. a vehicle overturning.

The cardanic suspension of the sealing disc 15 serves to provide a uniform sealing effect, to an extent dependent upon the different dimensions of the retainer elements 17, 17', along the valve seat 19 and the guide mandrel 11 even when the valve is in an inclined position, since any offset of the axes of the floating body 3 and of the housing 1 can be compensated for.

The state illustrated in Figure 4 where the valve starts to open anew following on from a closed state is characterised by the fact that the sealing disc 15 becomes gradually detached from the valve seat 19, wherein the detachment procedure is initiated as a result

of the movement of the floating body 3 in the direction towards the base 1' of the housing 1 by virtue of the retainer element 17 which in axial terms is relatively shorter, and correspondingly the valve begins to open at a point on the periphery of the valve seat, so that the sealing disc 15 assumes a temporary inclined position with respect to the axis 5. The expenditure of energy required for the detachment can be kept low in this manner.

Furthermore, the detachment procedure also initially causes the projection 16 to lift off from the guide mandrel 11, with the consequence that starting from the inlet orifices 4 a continuous connection 16' is established via the projection 16 to the outlet orifice, thus further facilitating the detachment procedure.

A bleed valve of this type, in particular its housing, can be disposed in the wall of the fuel tank, in this case it can form a supporting structure on the outer side or can even protrude at least partially into the tank. As an alternative to this wall attachment, it is also possible to use a particular holding device, in which the housing is received and which provides a connection to the said outlet orifice, wherein this holding device is held on a pump unit or another component or is disposed together with an independent line system on the inner side of the tank.

As a result, a structural element intended for use in a fuel tank is provided with the bleed valve in accordance with the invention and is characterised by a simple structural design and satisfies all operational requirements in a reliable and reproducible manner.